WWR-M REACTOR NEUTRON SPECTRUM STUDY AT 3 - 25 MEV BY DIFFERENTIAL PROTON RECOIL METHOD

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The fast part of the WWR-M reactor spectrum (fuel enrichment 36% of U-235) practically coincides with neutron spectrum from the U-235 thermal fission. Its research may allow
a) to test a theoretical conceptions of neutron emission at fission,
b) to search an abnormal energy-release at the heavy nuclei fission,
c) to consider high threshold neutron reactions in the chains of accumulation of radioactive nuclides such as U-232 and Pu-236 which complicate the fuel cycle radiation conditions.

To clarify both the reactor spectrum fast part shape and a question of the neutron excess in fission spectrum above 15 MeV, the spectrum of neutrons from the WWR-M reactor horizontal channel was studied. The differential proton recoil method at the angles of scattering 30, 35, 40, 45, 50, 55 degrees was applied. The spectra measured at the angles of 35, 40, 45, 50 degrees overlapped the energy interval 6 - 18 MeV. Measurements at the angle of 30 degree allowed to study the spectrum from 3 to 12 MeV and at the angle of 55 degree - from 8 to 25 MeV. At reconstruction of the neutron spectra braking protons in the polyethylene radiator, the energy dependence of (n,p) scattering cross section, and anisotropy of scattering above 12 MeV were taken into account. The neutron spectra were approximated by Maxwellian distribution E = E**(1/2) exp(-a0 E) whence "statistical" error of the parameter alpha (a0) was determined. This method allows to investigate a shape of the neutron energy spectrum above 15 MeV with an error about +- 10 %; in this case practically all uncertainty is connected with the angular dispersion of the outgoing protons.

It was carried out 5 series of the measurements. In the energy interval 3-12 MeV in most cases the values of parameter alpha lie in the range 0.609 -0.750. For the case of loading "fresh" fuel elements (in vicinity of our horizontal channel) the measured neutron spectrum is in a good agreement with U-235 fission spectrum and has parameters: a0 = (0.750 ± 0.010) 1/MeV, temperature T = (1.334±0.018) MeV, average energy E = (2.000±0.027) MeV. The analysis high energy range (above 15 MeV) for the measured spectra points to more hard character spectrum (average energy 3 - 5 MeV).

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